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Mapping Design Skills

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ABSTRACT

During a university major restructure it was decided that Industrial Design, a four year degree taught at Penrith campus, and Design and Technology, a three year degree taught at Campbelltown campus, would be delivered and taught across campuses by a combined group of academics. This was a catalyst for an in-depth examination of assessment tasks over the two programs. The extended exercise aimed to identify the skills which students require in order to successfully complete their final year project, and to review how and where the requisite skills were taught and assessed in core units over the preceding three years. The exercise also aimed to identify any gaps where students' skills were not being progressively built up to the requisite levels. The assessment and skills analysis was undertaken within a series of workshops where all academic staff from the two design programs engaged in collaborative processes, supported by an industry representative and university teaching development and learning development staff. The process of mapping skills adopted a proactive approach which recognised the benefits of embedding academic skills across the curriculum in order to achieve long-term, sustainable learning outcomes. The process enabled staff to gain a more detailed understanding of skills assessed and taught over the course of the programs, and to identify improvements for both programs. The paper describes the processes used and tools developed by the team in undertaking this project. Outcomes of the process include the implementation and embedding of academic literacy skills in first and fourth-year units, and a restructure of the fourth year and implementation of two fourth-year parallel streams.

INTRODUCTION

The paper describes a curriculum development initiative in Industrial Design (ID) at the University of Western Sydney. The initiative was planned and run collaboratively by key program staff and staff from the University's Teaching Development Unit (TDU).

The curriculum project engaged all ID academics in a collaborative process to analyse the skills needed by 4th year Industrial Design students in order to competently undertake their final year major project. In the 4th year project, students continue learning through integrating, applying and extending what they have learnt over the first three years of the degrees (Bohemia, 2004; Bohemia & Harman, 2006). The project interpreted the concept of skill broadly as having cognitive and perceptual as well as motor components (Brown, Bull, & Pendlebury, 1997:33-34). When students are using skills, they are calling upon knowledge, understanding and attitudes. Therefore, it is important that student assessments capture these, so, that they can be interpreted and assessed by academic staff..

Following the skills analysis, ID academic staff mapped where and how the required skills were taught to and applied by students in core units over the preceding three years of their program. Through a structured collaborative process, they then determined which of the identified skills were most in need of improvement.

This project achieved a number of practical outcomes such as the increased integration of course units and a strengthened focus on quality within course delivery. The project also generated longer term outcomes for the teaching team. Engagement in the goal-oriented, collaborative process provided a foundation for ongoing conversations about teaching and curriculum amongst group members. Teaching in higher education is commonly a private process (Shulman, 1993). While planning of teaching and assessment strategies is overseen through collegial processes, the enactment of teaching, learning and assessment is commonly left to individual academic staff to implement (Palmer, 1993). The dialogue on teaching, learning and assessment which occurred during this project established for members the value of talking about teaching in terms of producing practical outcomes. The collaborative work undertaken created a foundation for continuing improvement of teaching, learning and assessment within the team. Continuing changes to curriculum have built on the work started together in early 2003.

MOTIVATION FOR UNDERTAKING ASSESSMENT AND SKILLS ANALYSIS

The University of Western Sydney services a vast area of Greater Western Sydney through its six major campuses. The campuses are spread over a geographical area of almost three-quarters of Sydney, or more than 2000 square kilometres. During 1999-2000, the university went through a major restructure where its federated structure, with three member institutions which operated as separate entities, were merged into a single multi-campus university (UWS, 2005).

During this restructure it was decided that, from 2002, the Industrial Design degree, a four year degree taught at Penrith, and Design and Technology, a three year degree taught at Campbelltown, would be combined and taught across both campuses. The existing degrees were to remain and each degree was offered at both campuses, but they were to be rationalised. This meant that staff who had previously been attached to either one or the other degree program were required to teach on both degrees and to travel to both campuses.

The initial stages of merging the two degrees was achieved with relative ease as the Industrial Design units were retitled using unit names from the Design and Technology degree and provided with a new unit code. The Design and Technology 3-year program was embedded into the Industrial Design 4-year program, that is, the first 3 years of both degrees were identical.

Agreeing on the units' content however, was a much more difficult issue. In an attempt to overcome this impasse, a number of workshops were organised where academic staff and industry representatives aimed to agree on a set of competencies an Industrial Design graduate would possess. Table 1 lists core competencies agreed upon, in order of importance.

Table 1 Core Ideal Competencies of an Industrial Designer Graduate, Devised by Academic and Industry Representatives in early 2002

Core Competency
1. Translate to Others
2. Understand Society
3. Understanding of Self
4. Human Factors/Fit for Purpose
5. Material Knowledge
6. Marketing Knowledge
7. Engineering/Technology
8. Commercial
9. Documentation/CAD
10. Usability Studies [Fit for Purpose]
11. Management [Systems Facilitation]
12. Sustainability/Strategic Issues
13. Future Studies/Issues
14. Innovation through Creativity
15. Have Bob + John[1]
16. Legal

Although staff agreed on the competencies ID graduates would have, tracking where these competencies were developed within the curriculum proved difficult for a number of reasons:

(a) No one ID staff member had a full overview of the content which was taught in each of the units, as each individual ID staff 'imported' their unit content from the previously separate degrees, i.e. Industrial Design or Design and Technology;
(b) There was uncertainty how each of the above 'core competencies' related to each other and to what level students should achieve each competency;
(c) Most importantly, without understanding the content of every unit in the degree including learning aims, staff could not map and track where core competencies were developed within the existing degree program.

To move forward in the process of merging the two degrees, key program staff in Industrial Design collaborated with the University's Teaching Development Unit to plan and put into action strategies for increasing the scope and depth of awareness which academic staff had of the overall degree programs (Industrial Design and Design & Technology). All program staff were brought together to discuss and agree on objectives for a course familiarisation and renewal process. A whole team approach to this process encouraged exchange of knowledge and promoted ownership of outcomes. Harwood and Clarke point out that ongoing dialogue amongst team members enables open discussion of issues and problems-arising in teaching and that shared decision-making "…leads to common ground in terms of mutual satisfaction" (2006:30). Mutual satisfaction with the appropriateness of the process supports implementation of solutions developed. It was also recognised that while it was essential to involve all staff in the curriculum analysis and renewal process, including deciding what meetings to have and when and what information is to be collected and presented, a sufficient rate of progress would only occur if the process was driven by a smaller group (Toohey, 1999:33).

At the consultative meeting, ID staff identified a number of directions they wished to pursue. These included: becoming more aware and informed about each other's teaching practices in the two degrees; becoming more aware of how units build upon each other; identifying core competencies and graduate attributes and understanding how these are addressed in each unit; sharing strategies and tactics used in teaching as well as in negotiating the institution; and documenting units in the degrees. Intended objectives for the overall project as identified by ID staff, thus fell into two broad groupings: sharing knowledge about the degrees and units, and sharing knowledge about teaching.

In response to this, two strands of activity were set in train. The first strand of activity was an assessment skills analysis and mapping project, and associated curriculum renewal. The skills analysis and mapping project is the focus of this paper and is henceforth referred to as 'the project'. A second strand of activity was also established: a bi-monthly program of seminars which enabled staff to reflect on their teaching in dialogue with colleagues. This Reflection of Teaching seminar series ran alongside the skills project, beginning in 2003 and continuing to the present time. While this paper does not focus on the detail of the seminar series, the series

[1] Bob and John were two external industry staff who assisted with the development of these competencies. Bob and John utilised their specific competencies to run a successful industrial design constancy. Bob was an engineer and John was an artist. So, having a Bob and John meant to be able to address technical and creative problems.

has been a contributory factor in the success of the mapping skills project, enabling staff to focus in some detail on aspects of their own teaching practice and to get feedback from their colleagues.

The skills analysis and mapping project was designed to take into account constraints such as availability of staff to participate in workshops, and the necessity for staff to perceive that each block of time contributed by them produced tangible progress towards the outcome. There was an initial level of enthusiasm amongst ID staff for the project, but there was also a level of hesitation due to the scale of the undertaking and existing teaching and research commitments. It was essential to the success of the project that staff perceived value from their commitment of time and that they were able to identify that progress was being made during the project. In designing the whole team workshops that formed the backbone of this project, the project planners were mindful of these tensions. Staff participating in the project included all permanent and some casual teaching staff as well as an industry representative, and colleagues from the Library and the Learning Skills Unit.

FOCUSING THE PROJECT ON ASSESSMENT & SKILLS DEVELOPMENT

It was decided to focus the project on assessment as the means of extending staff familiarity with the Industrial Design and Design & Technology degrees. Assessment is the component of the curriculum that all students actively engage with (Briggs, Gustafson, & Tillman, 1991; Fry, Ketteridge, & Marshall, 2003); it is assessment which defines for students 'the actual curriculum and the content. (Ramsden, 1999:187). The work of Biggs (1999) also informed the design of this mapping project. Biggs highlights the significance for learning of what the student does: supporting students to competently undertake assessment tasks is likely to lead to maximum learning payoff.

Staff supervising final 4th year students had observed that students entering their last year of studies were often insufficiently prepared to undertake all aspects of their year-long project. Decisions about curriculum changes would be grounded in analysis of the skills required for the 4th year major project.

THE PROCESS

The process involved three stages:

(1) identifying and agreeing on the skills required by 4th year students to competently undertake their year-long major project;

(2) identifying skills used by students in doing assessment tasks over the first three years and mapping development of these skills in the core units through analysis of assessment tasks

(3) determining which skills were most in need of improvement across the degrees, through identifying the importance of each skill to successful completion of the 4th year project, and cross-referencing this with knowledge of how well each skill was actually performed by students.

In the first stage of the process, all ID staff participated in a one-day workshop, to explore and reach consensus on what skills students needed to undertake their 4th year assessment task. The two 4th year units: project commencement and project completion were examined in detail, as a whole group exercise. Having all staff work collaboratively on this exercise also established a shared understanding of the process involved in mapping skills. The exercise produced a list of 103 skills required by 4th year students.

In the second stage, the identification and mapping of skills process was applied to the fourteen core units taught over the preceding three years of the degrees, to determine how well these units cumulatively prepared students for 4th year study and assessment. Staff worked in small cross-disciplinary groups of ID staff plus either an industry representative or a member from one of the support units such as the Library, Learning Skills, or Teaching Development. Toohey highlights the usefulness of involving other university staff who have a role in supporting student learning, indicating that such "…staff may have much relevant experience of the student body to contribute, including knowledge of which concepts and skills students find most difficult to acquire" (1999:34). The input from Learning Skills and Library staff was particularly valuable in ensuring that the full range of skills implicit in each assessment task were identified.

Each group focused on analysing assessment tasks for one of the following types of skills: industrial design skills; maths and science skills; written communication skills; information literacy skills; or non-written communication skills. For each unit, groups were provided with an A3 worksheet, the current unit outline and additional assessment information which had been provided by the unit coordinator. The initial examining group for each unit used the A3 worksheet to note down assessment tasks detailed in the documentation and then discussed and reached agreement as to what skills (representative of their skills grouping) students would use in each assessment task. The A3 worksheet and unit documentation then passed to the next group. This process continued until all five groups had discussed and recorded skills used in assessments. At the end of the workshop, a map of assessment tasks and requisite skills had been produced for each of the core units.

The use of a process where all staff examined assessments in each of the core units increased awareness of patterns of student learning (evidenced through assessment tasks) across the degrees, a major goal of the skills analysis process. It helped staff identify where students were learning and using skills before arriving in their own units, and how the skills which students acquired and practised in their own units were then built upon by later units. Despite the full day taken by this activity, staff expressed satisfaction with the process and the outcomes.

After this workshop, unit coordinators reviewed the completed worksheets and noted whether the skills listed were explicitly taught within the unit or whether students were assumed to possess these skills on entry to the unit.

On a subsequent day, the list of 103 skills compiled previously was pared back to 93 after staff discussed and

agreed upon how they interpreted each skill. Research by Fraser (2006) published since this stage of the project confirms the critical role of collegial dialogue to develop a shared understanding of terms used in discussing curriculum change.

For practical purposes, the skills list was categorised into the following ten sections for more detailed mapping across the curriculum: research; technical; project and time management; analytical/critical thinking; creativity and innovation; strategic thinking; legal and ethical considerations; presentation/communication (written and verbal); people skills; presentation/communication (visual). A spreadsheet was constructed to record skill development across the core units. As part of this mapping process, staff noted whether the skill was taught and/or applied in each unit. Where the skill was taught within a unit, the depth to which it was taught was recorded, on a scale of T1 – T3, with T1 indicating brief teaching and/or learning coverage and T3 indicating intensive teaching and/or learning coverage. This data was used to identify where the programs were not adequately preparing students to develop necessary skills. Where gaps were identified, the group discussed and agreed upon the units in which skills should be taught and/or applied. This information was recorded on the spreadsheet. Decisions made collaboratively as to changes were used by relevant unit coordinators to make changes to their units. For example, one of the first year unit coordinators, with assistance from Learning Student Unit, redeveloped the unit to incorporate academic literacy skills (Power, Bohemia, Farrell, & Yevenes, 2005). Other staff worked together to rearrange learning requirements across three individual units in the field of Sustainable Design, so that the learning outcomes in later unit built upon learning outcomes from the previous unit.

In the third stage of the project, the skills listing was used as the basis for identifying areas in which students were most deficient and most in need of development. The 93 skills were ranked by ID staff in terms of their importance to student learning and achievement in 4th year and cross-referenced with the current level of performance by students entering 4th year. Skills that were ranked high in importance but low in level of current performance were thus identified as being the most pressingly in need of attention by staff. The top 10 'deficient' skills, in order of gap between importance (scored high) and performance (scored low) were:

1. Technical drawing to AS1100[2]
2. (Use of appropriate) Standards
3. Literature review
4. Technical drawing[3]
5. Ergonomic testing/user testing
6. Quality Assurance (measurement) and Testing
7. Critical thinking
8. Construct questions for research
9. Annotated Bibliography
10. Synthesis – design brief

The top ten list surprised most ID staff, given that a substantial part of the degrees were dedicated to teaching Computer Aided Design (CAD) skills. Because of this CAD component in the degrees, it had been assumed that students would be adequately skilled in constructing good technical drawings.

OUTCOMES FROM THE PROCESS

A major outcome of the process was an increased awareness of what was taught, learnt and assessed across the program. Academic staff gained a more holistic and at the same time, more in-depth understanding of the program which has enabled them to make ongoing changes to the curriculum.

The activities described in this paper supported a major course review and curriculum development. The following significant outcomes have been achieved:

- Introduction of continual improvement strategies. For example, every unit coordinator has prepared and submitted change proposals for their units.
- Timely and positive participation in 2004 UWS Academic Program Planning Process (APPP) process and enthusiastic uptake of the APPP final recommendations.
- The development of a major course change for the Industrial Design program including:
  - The introduction of two new two final-fourth year units
  - Achieving compliance with the current UWS Embedded Honours policy, including the ability to stream the final year students into Honours or Coursework programs
  - Altered sequence of two units so that the units' level of complexity and learning objectives are aligned with the overall course objectives
  - Creation of four new Majors which include units from across the University in order to follow the UWS review recommendations
  - Revision of the first year units sequence
  - Realignment of the Design & Technology course with the Industrial Design course in order for students to be able to seamlessly move between the two degrees, thus providing students with greater choice
  - Introduction of three sub-majors into the Design & Technology course.

In addition, Industrial Design staff have taken on the complex task of developing two of new School-wide first year units. Both units have been introduced and are providing an exciting opportunity for the School to engage the first year student cohort in a novel learning environment. The first unit was developed in collaboration with staff from the Learning Student Unit (LSU). The unit's assignments were designed in the context of the outcomes of the mapping skills process and the focus was on embedding academic literacy skills in this unit. In order to do this, Industrial Design and LSU staff developed *Academic Literacy Resource* booklet tailored to

[2] AS1100 = Australian Standard guide for Technical Drawings

[3] Generating comprehensive technical drawings but not necessary to AS1100 level

the requirement of the written and oral assignments which was used in this first year core unit. This *Academic Literacy Resource* booklet provided an introduction to skills with an emphasis on critical/reflective thinking. It included a range of topics such as: Effective Reading, Note Taking, Writing Annotated Bibliographies, Writing and Presenting Seminar papers in addition to sample academic texts which were annotated to highlight the required features of this genre of academic writing.

The second unit was developed in collaboration with engineering staff. In this unit students were given a task to construct individualised key-ring CAD model which was then printed on 3D printer and given to each student in order for them to see the physical representation of their digital models (CAD). In addition to this, four units which teach CAD skills have been reviewed and assessments modified.

ELEMENTS OF THE PROJECT THAT FACILITATED SHORT- AND LONG-TERM OUTCOMES AND SUGGESTIONS FOR OTHERS INTERESTED IN USING OR ADAPTING THIS MODEL OF CURRICULUM DEVELOPMENT

A number of factors have facilitated the outcomes generated through this project. Focusing on assessment tasks and the skills that students use in doing assessment ensured that curriculum changes made as a result of the project would have maximum learning payoff for students.

From the staff perspective, early outcomes from the project included establishing a positive attitude towards the curriculum renewal process. While there were variations in the degree to which individual ID staff engaged with the curriculum project, involving all teaching staff in setting directions for the project was a positive first step: this was acknowledged as such by staff. Seeking and gaining consensus on the skills required by beginning 4th year students was essential in terms of producing a reliable and widely accepted basic process for the project. Developing a shared understanding of what was meant by each of the skills was important in arriving at curriculum decisions that were accepted by all the teaching team.

Designing practical ways for all teaching staff to contribute their knowledge of units and assessment tasks ensured that this vital information was tapped and used. Recording the information generated by staff in the workshops and circulating this to everyone meant that staff had ongoing access to information about which parts of the curriculum developed which skills, and to what extent. The records produced provided evidence of tangible outcomes being achieved during the project. Although the project didn't make use of an electronic repository to store documents, the authors recognise that this would be useful for any future projects of a similar nature.

Providing a way for staff from University support services to contribute their knowledge and to interact with ID staff as they were thinking through assessment tasks and skills required was vital in achieving the positive outcomes of the project.

The reflection on teaching seminar series which ran alongside the curriculum project contributed to the momentum of the project by providing a forum for staff to focus on their individual teaching and facilitation of student learning.

The literature on curriculum development suggest that ongoing processes to develop, implement and maintain courses need resources such as time allocation (e.g. Briggs et al., 1991). Despite the excellent outcomes from this project, time allocation for teaching staff participating in the project was not recognised in the workload model at the time. The authors suggest that any future projects of a similar nature consider and resolve workload implications at an early stage.

CONCLUDING REMARKS

With the intention of making this curriculum development model available to others, this paper has described in some detail the collaborative processes undertaken and the tools used by the curriculum team in an initiative to improve 4th year assessment for Industrial Design students at University of Western Sydney. This method of grounding a curriculum project in final year assessment was particularly useful in the Industrial Design context, where all 4th year students do the same last two units which require them to integrate and use the skills acquired throughout the degree. Grounding the curriculum project in student activity for assessment has produced a range of positive outcomes for staff and for students. The whole group curriculum development processes used were effective in extending and strengthening the team's awareness of assessment, teaching and learning across the program.

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